sippi Valley we receive four or more in this section of the country. Thus, if we consider the progress which should be made by growing crops by considering only the one climatic element, sunshine, the crops in the semiarid region should make as much progress in three months as the same crops would make in four months in the Mississippi Valley. I believe that the high percentage of sugar in the beets raised in this western country is due to the high percentage of sunshine which they receive during their period of growth. I do not wish to carry the discussion of this subject further, but I wish to say again that I believe that this subject has not received the consideration that it should.

SEED BREEDING.

The seedsmen of the northern districts of this country have always contended, and with good reason, that northern-grown seeds are the best; to this the seedsmen of the western districts should add that the higher the elevation at which seeds are grown, other conditions being identical, the better will be the seeds. The dry farmer can, with equally as good reason, contend that the seeds which are produced with the minimum amount of moisture for their successful production are superior to the seeds which have been grown where an excess of moisture has been used. That section of the country which combines the three conditions, namely, a northern latitude, a moderate elevation above the sea level, and a rainfall not in excess of the actual needs of plant growth, should prove to be a place where the very highest class of seeds can be produced.

EXTENSION OF FARMING DISTRICTS.

The farming belt of this country was a few years ago brought to the eastern edge of the semiarid region and within the last few years it has been rapidly covering, by irrigation and so-called dry-farming methods, large areas of what was once known as the Great American Desert. Crops are being successfully and profitably produced in regions where a few years ago it was considered that the precipitation was not sufficient to raise crops. This has not been due to a change in the climate of any part of our country, because the life of man is too short to see any change in the climate of any section; the weather of the successive years may and does vary somewhat, but our climatic conditions persist. Man has been learning how to conserve the moisture which falls, and to adapt the proper crops to the conditions of a limited rainfall. These are two lines of study which must be carried along until all of the available lands of our country, even in regions of a rainfall of less than 10 inches, can be successfully used for the production of some kind of a crop.

ATTENDANCE ON SCIENTIFIC MEETINGS.

By W. J. HUMPHREYS, Professor of Meteorological Physics. Dated Washington, January 26, 1909.

The phenomena and the processes of nature are so interdependent, and the methods of investigating them so numerous, that only he is prepared to work in any science to greatest purpose who has a sympathetic appreciation for all sciences, and an increasingly minute knowledge as his own specialty is more nearly approached. There is no exaggeration in the statement that he needs to know everything about something and something about everything, for nothing short of this can give him that accuracy and that resourcefulness essential to the solution of difficult problems, nor that alertness and breadth of view so necessary to the detection and to the understanding of new phenomena.

These statements, while universally true, apply with peculiar force to meteorology which, besides demanding a knowledge of mathematics and of every branch of physics, in one way or another comes in the closest touch with astronomy, geology, chemistry, and biology, and with practically every other science, so extensive and so profound are the effects of its phenomena. And because of this intimate relation to so many sciences, it is especially important for the meteorologist to prepare articles for and to attend such important meetings as those of the American Association for the Advancement of Science, of the affiliated national and of other societies, for there are sure to be read at these meetings many papers of interest to him, and besides his own contributions are certain to receive all that attention and respect they deserve. But far better than the information he will get from the papers he will hear, or from the discussion of his own, will be the effect upon him of the enthusiasm inspired by the association thus secured, even tho temporary, with the productive scholars of the entire country; an enthusiasm that welcomes scientific difficulties and leads, thru persistent attack, to their ultimate solution.

Any one, whether public official or private citizen, whose position presupposes scholarship, and gives him an opportunity to work—and in this connection opportunity implies duty—and who does not, whenever practicable, attend such meetings, by his absence makes the absurd declaration that he can work as well without encouragement as with it; that enthusiasm to him is useless; and that acquaintance and association with the world's best scholars can do him no good, or else confesses that, neither taking part in creative work nor caring for it, he is an intellectual sluggard blocking, so far as one man can, the world's progress by filling a position for which he is utterly unworthy.

In the name of every art and of the science that is back of it, in the name of civilization and of all human progress, let no position that offers the sacred privilege of doing work be filled save by him who realizes his duty.

It would be absurd, of course, to claim that to become a productive scholar it is sufficient to attend these gatherings of scientific men (exceptional native ability, wisely and persistently trained, is the only means to such an end), but it can not be emphasized too strongly that wherever bonds outrank brains, wherever society fads pose as scientific facts and meaningless gibberish passes for profound learning, such meetings, by furnishing the encouragement his sensitive nature craves, prolong the scholar's active period and increase both the quantity and the quality of his work.

These are some of the reasons in general terms why the writer urges fuller assemblages of all scientific men. But for any meteorologist who may be disposed to ask for more specific information as to how he could be benefited, the following list of papers, selected from the many read at Baltimore before the various societies during the convocation week of December, 1908, is appended. It is not a complete list, for there were other papers the meteorologist might do well to read; but it is extensive enough to show that his branch of geophysics was not neglected, even if he himself did chance to be absent.

Prof. Edward L. Nichols. Science and practical problems of the future. (Address of the retiring president.)

Prof. Dr. Albrecht Penck, Berlin University. Man, climate, and soil. (Public address.)

Maj. G. A. Squier, U. S. A. Recent progress in aeronautics. (Public address.)

F. R. Moulton. On certain implication of possible changes in the form and dimensions of the sun, and some suggestions for explaining certain phenomena of variable stars.

Phillip Fox and Georgio Abetti. The interaction of sun-spots.

A. Galline. On the diurnal variations in the intensity of the penetrating radiation present at the surface of the earth.

John Zeleny and L. W. McKeehan. An experimental determination of the terminal velocity of fall of small spheres in air.

G. E. Hale. Solar vortices and magnetic fields.

L. A. Bauer. A plea for terrestrial and cosmical physics.

John F. Hayford. Ellipticity of the earth is not a proof of a former liquid state.

J. E. Siebel. The thermodynamics of saturated vapors.

Henry E. Wetherill. The lumeter, a practical measure of general luminosity.

W. W. Strong. Ionization in closed vessels.

Alois F. Kovarik. Velocity of the negative ions produced by ultraviolet rays in various gases at different pressures and temperatures.

F. E. Nipher. Momentum effects in electrical discharge.

L. A. Bauer. Regarding recent magnetic storms.

W. J. Humphreys. Solar magnetism.

W. J. Humphreys. The upper inversion.

R. B. Dole and H. Stabler. Denudation in the United States.

Eugene C. Bingham. The relations between viscosity and fluidity.

E. W. Washburn. A simplification of the cyclic-process method for deriving thermodynamic equations.

Irving Langmuir. The formation of nitric oxide by the action of nernst glowers on air.

R. G. Mailey. The properties of water near the critical point.

J. E. Mills. The internal heat of vaporization.

H. E. Patten. Heat conductance of soils.

Bohumil Shimek. A preliminary report of the result of observations on the relation of evaporation to the treelessness of the prairies.

Gifford Pinchot. The conservation problem.

L. A. Bauer. Status of the magnetic survey of the earth.

Henry Gannett. The climate of Cuba.

A. Lawrence Rotch. The temperature at great heights above the American Continent.

R. DeC. Ward. The cylconic unit in climatological investigations.

Ellsworth Huntington. The climate of the historic past.

Robert M. Brown. The reservoir system of flood protection in the light of the recent floods of the Mississippi River.

C. H. Shaw. Vegetation and altitude.

V. M. Spalding. Local distribution of desert plants.

E. N. Transeau. The relation of the climatic factors to vegetation.

Lawence Martin. The Alaskan earthquake of 1899.

Harry Fielding Reid. Mass movements in tectonic earthquakes.

Charles R. Keyes. Deflation and the relative efficiencies of erosive processes under conditions of aridity.

D. T. MacDougal. Relation of plants to climate with special reference to pleistocene conditions.

The most important thing, potentially, for meteorology that happened during the Baltimore meetings, was the reading by Major Squier, of his valuable paper on aeronautics, and the consequent decision, on the part of Section D, to make aeronautics and aerophysics prominent features at the next and subsequent meetings of the association.

Aeronautics is sure to stimulate, as never before, the study of the directions, the turbulence, and the other properties of wind currents, and at the same time to furnish the best means for solving these and kindred problems; so that it is not too much to say that a new meteorological era, new in the extent of its usefulness, and new in the rapidity of its advance, is at hand. And he who in any way contributes to this advance will have done something of the greatest good it is given man to do; for to that extent, be it much or be it little, because of his labors and of his discoveries, the world will be wiser and the energies of men more productive.

A PROPOSED NEW FORMULA FOR EVAPORATION.

By C. F. Marvin, Professor of Meteorology. Dated March 21, 1909.

The attention of the writer has been called to the perplexities that have arisen in the discussion of evaporation observations at Reno, Indio, and elsewhere, whereby it seems that some factor influencing evaporation is missing, as it were. The whole subject is very fully discust by Professor Bigelow[1] in a series of papers in the Monthly Weather Review.

The observations seem to indicate in certain cases that notably different amounts of evaporation are observed under seemingly the same meteorological conditions, or, that the same amounts of evaporation are found when the observed meteorological conditions are notably different. The writer has not had an opportunity to closely scrutinize the original data, but, with a view of bringing in a different and perhaps a new and independent line of thought on this problem, I have endeavored to take up *de novo* the general question of the evaporation equation. The results of this study are given in what follows.

Let us imagine we have a free surface of water, perfectly smooth, with dry air over it.

The kinetic theory of vapor tells us that molecules of water vapor are being continually shot out thru the superficial film of the water surface into the air above and beyond. Let us suppose, to start with, that these molecules are able to escape to an indefinite distance from the water surface so that they can not return. The water thus lost is the true or absolute evaporation that can take place under the given conditions. Now, we believe that there are only two conditions that can influence the amount of water thus evaporated. We know that if the water is warm the molecules are shot out faster than if it is cold. We also know that the greater the pressure or density of the air or gas over the water the slower will be the evaporation. Remembering that we have assumed that all the molecules shot out escape from the water entirely, we do not see that any other conditions can influence the absolute rate of evaporation. We recognize, of course, the effects of impurities in the water, etc.

If T_s is the water surface temperature, and B is the atmospheric pressure, then the conclusion we have just stated may be represented, mathematically, by the expression:

$$\text{Absolute evaporation, per unit of time, varies as } \frac{T_s}{B}.$$

Our assumed conditions, however, do not represent any ordinary state in nature. The molecules shot out from the water can not all escape. They collide with each other and with the air particles so that their complete escape is quite impossible. In fact, much of the moisture evaporated becomes entangled in the thin layer of mixt air and vapor near the water, and many of the vapor particles in this layer shoot back into the water; consequently, the *apparent* evaporation, which is the only thing we can measure, and which now concerns us, is the difference between the vapor shot out from the water and that which returns from the overlying gaseous sheet.

The object now in hand is to formulate an equation that shall express as nearly as may be the relation between the surrounding conditions and this apparent evaporation. As we have already seen, the rate of evaporation will be greater and greater the higher the temperature of the water. It will also be greater the higher the temperature of the sheet of air and vapor over the water, because the higher this temperature the greater is the capacity of this space to receive and disseminate moisture. On the other hand the rate of evaporation will be less the greater the quantity of vapor already present in the overlying gaseous sheet. It will also be less the greater the gross barometric pressure. Finally, the more the wind blows the faster will dry air replace the moist and thus make faster evaporation possible.

[1] Bigelow, F. H. Monthly Weather Review, July, 1907, p. 311; February, 1908, p. 24; Summary, 1908, p. 437.